We greatly appreciate the referee's comments on our manuscript entitled “Tropospheric photooxidation of CF$_3$CH$_2$CHO and CF$_3$(CH$_2$)$_2$CHO initiated by Cl atoms and OH radicals”, by M. Antiñolo, E. Jiménez, A. Notario, E. Martínez, and J. Albaladejo.

1) Comment on the possible Cl atom regeneration

As stated on Page 24792 of the manuscript the Cl decay profiles were observed to be biexponential after photolysis of Cl$_2$/aldehyde mixtures. Similarly to other Cl-reactions where Cl$_2$ was used as a Cl photochemical precursor, the chlorine atom regeneration could be explained by the reaction of CF$_3$(CH$_2$)$_x$CO radicals with Cl$_2$:

$$\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{Cl}_2 \rightarrow \text{CF}_3(\text{CH}_2)_x\text{COCl} + \text{Cl} \quad (14)$$

After adding O$_2$ as a radical scavenger, the Cl decay profiles became monoexponential, indicating the predominance of reaction (15) versus reaction (14):

$$\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{O}_2 \rightarrow \text{CF}_3(\text{CH}_2)_x\text{C(O)O}_2 \quad (15)$$

As stated on Page 24792 of the manuscript no kinetic data on the reactions (14) and (15) are available in the bibliography. Therefore in this work the kinetic behaviour of CF$_3$(CH$_2$)$_x$CO radicals was assumed to be similar to that of CF$_3$CO radicals (smallest fluorinated radical of the series, $x = 0$) rather than CH$_3$CO radicals used by the reviewer. in this way, the deactivating effect CF$_3$ group is included in the estimation. Of course, the effect of the methylene groups (when $x = 1$ and 2) on $k_{(\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{O}_2)}$ and $k_{(\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{Cl}_2)}$ is not known, but it would be expected an increase in both rate coefficients. Again, the magnitude of such an increment is not known.

$$\text{CF}_3\text{CO} + \text{Cl}_2 \rightarrow \text{CF}_3\text{COCl} + \text{Cl} \quad 6.1 \times 10^{-13} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1} \quad \text{(Maricq et al., 1995)}$$

$$\text{CF}_3\text{CO} + \text{O}_2 \rightarrow \text{CF}_3\text{C(O)O}_2 \quad 7.3 \times 10^{-13} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1} \quad \text{(Wallington et al., 1994)}$$

Thus, as an approach we assumed $k_{(\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{O}_2)} / k_{(\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{Cl}_2)} = k_{(\text{CF}_3\text{CO} + \text{O}_2)} / k_{(\text{CF}_3\text{CO} + \text{Cl}_2)} = 1.2$. The worst scenario corresponds to a low O$_2$ concentration and high Cl$_2$ concentration, what is presented on Page 24792 of the discussion paper $([\text{O}_2]) / [\text{Cl}_2]_0 = 50$. However, the highest $[\text{O}_2] / [\text{Cl}_2]_0$ ratio employed was up to ca. 70. Considering these concentration ratios and $k_{(\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{O}_2)} / k_{(\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{Cl}_2)}$, the rate
ratio \( \frac{k_{\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{O}_2}}{k_{\text{CF}_3(\text{CH}_2)_x\text{CO} + \text{Cl}_2}} \) would range from 60 to 84. In other words, about 98% of \( \text{CF}_3(\text{CH}_2)_x\text{CO} \) would react with \( \text{O}_2 \) and only 2% of those radicals would regenerate Cl atoms. Further, and as can be seen in Figure A, Cl temporal profiles (in log scale) are linear over usually two lifetimes, indicating that the Cl regeneration has been minimized as in other previous works. Therefore, Cl-regeneration can be considered negligible under our experimental conditions.

As suggested by Referee #1, some examples of the Cl temporal profiles could be included in the revised manuscript or in the supplementary information.

**Effect of temperature in the possible Cl-regeneration**

Referee #1 suggests that Cl atoms could regenerate faster at high temperatures if the activation energies of the reaction of \( \text{CH}_3\text{CO} \) radicals with \( \text{O}_2 \) \((E_a = 0)\) and \( \text{Cl}_2 \) \((E_a/R = 47 \text{ K}, \text{Tyndall et al. (1997)})\) are taken into account. The reaction of \( \text{CH}_3\text{CO} \) with \( \text{Cl}_2 \) was studied at temperatures below 298 K (298-228 K). If we extrapolate those results at \( T > 298 \text{ K} \), the rate coefficient \( k_{\text{CH}_3\text{CO} + \text{Cl}_2} \) at the highest temperature \( T = 371 \text{ K} \) is \( 2.47 \times 10^{-11} \text{ cm}^3\text{ molecule}^{-1}\text{ s}^{-1} \), implying an increase of 0.3% in the
possible Cl regeneration. So, under these “speculative” conditions, the Cl regeneration would be within the experimental uncertainties.

Again, the magnitude of the effect of temperature on $k_{(CF_3(CH_2)\times CO + O_2)}$ and $k_{(CF_3(CH_2)_{2}CO + Cl_2)}$ is not known and further studies on these reactions at 298 K and above would be helpful. However, the experimental decay profiles obtained for Cl atoms at high temperatures (see Figure A) show that there is no appreciable Cl-regeneration.

Effect of addition of different O\textsubscript{2} concentrations

The following statement on Page 24792 of the discussion paper is not precise enough and it will be changed in the revised manuscript: “A few experiments were performed with $[O_2] \sim 2 \times 10^{16}$ molecule cm\textsuperscript{-3} for a limited range of aldehyde concentrations, and the obtained rate coefficients were similar to those obtained with $[O_2] \sim 1 \times 10^{16}$ molecule cm\textsuperscript{-3}”. Despite the reduction of the signal-to-noise ratio, the initial $[O_3]$ was set between 1.0 and $2.5 \times 10^{16}$ molecule cm\textsuperscript{-3} over the T-range studied in order to ensure the minimization of Cl atom regeneration. For example, in Table A the values of $k_{Cl}$ at room temperature and at different pressures, were listed together with the initial O\textsubscript{2} concentration used in the experiments. Likewise, no difference on $k_{Cl}$ outside the error limits was observed at 298 K and other temperatures, as observed in Table B.

Table A. Rate coefficients $k_{Cl}$ for CF\textsubscript{3}CH\textsubscript{2}CHO and CF\textsubscript{3}CH\textsubscript{2}CH\textsubscript{2}CHO at 298 K and as a function of total pressure.

<table>
<thead>
<tr>
<th>p / Torr</th>
<th>$[O_2] \times \times 10^{16}$/molecule cm\textsuperscript{-3}</th>
<th>$(k_{Cl}\pm 2\sigma) \times 10^{11}$/cm\textsuperscript{3} molecule\textsuperscript{-1}s\textsuperscript{-1}</th>
<th>$[O_2] \times \times 10^{16}$/molecule cm\textsuperscript{-3}</th>
<th>$(k_{Cl}\pm 2\sigma) \times 10^{11}$/cm\textsuperscript{3} molecule\textsuperscript{-1}s\textsuperscript{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF\textsubscript{3}CH\textsubscript{2}CHO</td>
<td>CF\textsubscript{3}CH\textsubscript{2}CH\textsubscript{2}CHO</td>
<td>CF\textsubscript{3}CH\textsubscript{2}CHO</td>
<td>CF\textsubscript{3}CH\textsubscript{2}CH\textsubscript{2}CHO</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>1.6</td>
<td>1.52±0.07</td>
<td>1.5</td>
<td>3.34±0.19</td>
</tr>
<tr>
<td>100</td>
<td>1.7</td>
<td>1.53±0.06</td>
<td>1.7</td>
<td>3.41±0.79</td>
</tr>
<tr>
<td>150</td>
<td>1.9</td>
<td>1.60±0.06</td>
<td>1.9</td>
<td>3.24±0.53</td>
</tr>
<tr>
<td>200</td>
<td>2.1</td>
<td>1.48±0.06</td>
<td>2.2</td>
<td>4.00±0.22</td>
</tr>
</tbody>
</table>
Table B. Rate coefficients $k_{CI}$ for CF$_3$CH$_2$CHO as a function of temperature.

<table>
<thead>
<tr>
<th>T / K</th>
<th>$[Cl_2] \times 10^{14}$ / cm$^3$</th>
<th>$[Cl] \times 10^{11}$ / cm$^3$</th>
<th>$[RCHO] \times 10^{13}$ / cm$^3$</th>
<th>$[O_2] \times 10^{16}$ / cm$^3$</th>
<th>$(k_{CI} \pm 2\sigma) \times 10^{11}$ / cm$^3$ molecule$^{-1}$ s$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>268</td>
<td>3.7</td>
<td>4.3</td>
<td>0.92-8.0</td>
<td>1.7-2.5</td>
<td>1.37±0.10</td>
</tr>
<tr>
<td>278</td>
<td>3.2</td>
<td>4.6</td>
<td>0.80-7.5</td>
<td>1.8-1.9</td>
<td>1.42±0.10</td>
</tr>
<tr>
<td>288</td>
<td>2.9</td>
<td>4.0</td>
<td>0.79-7.7</td>
<td>1.6-1.9</td>
<td>1.38±0.11</td>
</tr>
<tr>
<td>298</td>
<td>3.2</td>
<td>4.5</td>
<td>0.39-15</td>
<td>1.5-2.2</td>
<td>1.55±0.22</td>
</tr>
<tr>
<td>316</td>
<td>2.5</td>
<td>3.8</td>
<td>1.8-17</td>
<td>1.3-1.5</td>
<td>1.67±0.38</td>
</tr>
<tr>
<td>331</td>
<td>2.4</td>
<td>3.6</td>
<td>1.6-15</td>
<td>1.5-1.2</td>
<td>1.75±0.32</td>
</tr>
<tr>
<td>351</td>
<td>2.2</td>
<td>3.4</td>
<td>1.8-12</td>
<td>1.3-1.1</td>
<td>1.80±0.36</td>
</tr>
<tr>
<td>371</td>
<td>2.2</td>
<td>3.4</td>
<td>1.4-13</td>
<td>1.0-1.7</td>
<td>1.84±0.15</td>
</tr>
</tbody>
</table>

Table C. Rate coefficients $k_{CI}$ for CF$_3$CH$_2$CH$_2$CHO as a function of temperature.

<table>
<thead>
<tr>
<th>T / K</th>
<th>$[Cl_2] \times 10^{14}$ / cm$^3$</th>
<th>$[Cl] \times 10^{11}$ / cm$^3$</th>
<th>$[RCHO] \times 10^{13}$ / cm$^3$</th>
<th>$[O_2] \times 10^{16}$ / cm$^3$</th>
<th>$(k_{CI} \pm 2\sigma) \times 10^{11}$ / cm$^3$ molecule$^{-1}$ s$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>268</td>
<td>3.1</td>
<td>3.8</td>
<td>1.3-11</td>
<td>1.6-2.2</td>
<td>2.85±0.45</td>
</tr>
<tr>
<td>278</td>
<td>2.9</td>
<td>3.6</td>
<td>1.5-13</td>
<td>1.6-1.8</td>
<td>2.98±0.20</td>
</tr>
<tr>
<td>288</td>
<td>2.7</td>
<td>3.7</td>
<td>1.3-11</td>
<td>1.5-1.9</td>
<td>3.20±0.14</td>
</tr>
<tr>
<td>298</td>
<td>3.0</td>
<td>4.1</td>
<td>0.75-21</td>
<td>1.4-2.2</td>
<td>3.39±0.70</td>
</tr>
<tr>
<td>316</td>
<td>2.4</td>
<td>3.6</td>
<td>1.2-11</td>
<td>1.3-1.5</td>
<td>4.05±0.46</td>
</tr>
<tr>
<td>331</td>
<td>2.3</td>
<td>3.3</td>
<td>1.2-10</td>
<td>1.3</td>
<td>4.60±0.24</td>
</tr>
<tr>
<td>351</td>
<td>2.3</td>
<td>2.8</td>
<td>1.3-11</td>
<td>1.2-2.3</td>
<td>4.79±0.74</td>
</tr>
<tr>
<td>371</td>
<td>2.1</td>
<td>2.6</td>
<td>1.2-10</td>
<td>1.0-1.4</td>
<td>5.13±0.41</td>
</tr>
</tbody>
</table>

2) Minor Comments

We agree with the reviewer that the statement on Page 24875 of the paper under discussion is too broad. The global warming potentials of HFCs range from 53 (HFC-152, $\tau = 0.6$ yr) to 14,760 (HFC-23, $\tau = 270$ yr) over an integration time horizon of 100 years (WMO, 2006). Generally, the higher the atmospheric lifetime for a HFC is, the higher its GWP will be. Of course, the radiative efficiency ($W \text{ m}^{-2} \text{ ppbv}^{-1}$) of HFCs is a determining factor in GWP (as it can be seen in Table D).

Thus, the statement on Page 24875 of the discussion paper will be changed by "Moreover, both of them (referring to HCFCs and HFCs) are in general very strong greenhouse gases with high Global Warming Potentials (GWP) commonly associated with long tropospheric lifetimes and strong absorption in the IR region".
Table D.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Radiative efficiency</th>
<th>tau</th>
<th>GWP (100-yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFC-23</td>
<td>0.19</td>
<td>270</td>
<td>14,760</td>
</tr>
<tr>
<td>HFC-32</td>
<td>0.11</td>
<td>4.9</td>
<td>675</td>
</tr>
<tr>
<td>HFC-41</td>
<td>0.02</td>
<td>2.4</td>
<td>92</td>
</tr>
<tr>
<td>HFC-125</td>
<td>0.23</td>
<td>29</td>
<td>3,500</td>
</tr>
<tr>
<td>HFC-134</td>
<td>0.18</td>
<td>9.6</td>
<td>1,100</td>
</tr>
<tr>
<td>HFC-134a</td>
<td>0.16</td>
<td>14</td>
<td>1,430</td>
</tr>
<tr>
<td>HFC-143</td>
<td>0.13</td>
<td>3.5</td>
<td>353</td>
</tr>
<tr>
<td>HFC-143a</td>
<td>0.13</td>
<td>52</td>
<td>4,470</td>
</tr>
<tr>
<td>HFC-152</td>
<td>0.09</td>
<td>0.6</td>
<td>53</td>
</tr>
<tr>
<td>HFC-152a</td>
<td>0.09</td>
<td>1.4</td>
<td>124</td>
</tr>
<tr>
<td>HFC-227ea</td>
<td>0.26</td>
<td>34.2</td>
<td>3,220</td>
</tr>
<tr>
<td>HFC-236cb</td>
<td>0.23</td>
<td>13.6</td>
<td>1,340</td>
</tr>
<tr>
<td>HFC-236ea</td>
<td>0.3</td>
<td>10.7</td>
<td>1,370</td>
</tr>
<tr>
<td>HFC-236fa</td>
<td>0.28</td>
<td>240</td>
<td>9,810</td>
</tr>
<tr>
<td>HFC-245ca</td>
<td>0.23</td>
<td>6.2</td>
<td>693</td>
</tr>
<tr>
<td>HFC-245fa</td>
<td>0.28</td>
<td>7.6</td>
<td>1,030</td>
</tr>
<tr>
<td>HFC-365mfc</td>
<td>0.21</td>
<td>8.6</td>
<td>794</td>
</tr>
<tr>
<td>HFC-43-10mee</td>
<td>0.4</td>
<td>15.9</td>
<td>1,640</td>
</tr>
</tbody>
</table>

Section 3.3. Impact of fluoroaldehyde chemistry on air quality

We agree with Referee#1 that the atmospheric abundance of fluorinated aldehydes is currently low. However, the possible widespread use of fluorinated alcohols as substitutes of HFCs will inevitably lead to an increase in fluoroaldehyde concentrations, since they are the major oxidation products. Thus, further studies on the degradation products of their homogeneous oxidation and UV photodissociation will be needed in order to evaluate the environmental impact of these fluoroaldehydes. So, the statement on Page 24798 is changed by:

“As the major degradation routes are reactions with OH radicals and UV photolysis, products of such processes should be known in order to evaluate the influence on the air quality”.